Library

DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA

HONOLULU
LA JOLLA
MONTEREY
TIBURON

SWFC

SOUTHWEST FISHERIES CENTER

MONTHLY REPORT - JANUARY 1979

TABLE OF CONTENTS AND RESEARCH HIGHLIGHTS

	Page
PUBLICATIONS	1
HONOLULU LABORATORY	2
Study on Food Habits of Seabirds Begun	4
Fish Aggregating Buoys Lost in Winter Storms	4
Work Begun on a New Approach to Problem of Determining Temperature Preference in Tunas	6
LA JOLLA LABORATORY	8
Growth Rates Estimated for Northern Anchovy and Northern Lampfish	9
Survival of Anchovy Larvae Related to Patchy Food Distribution	12
Olive Rockfish Larvae and White Croaker Larvae Reared in Laboratory	16
Draft Jack Mackerel Plan Presented to Council	17
Sakagawa Named Chief of Oceanic Fisheries Resources Division	20
Satellite-linked Porpoise Tracking System to be Tested	22
Survey of Porpoise Populations in the Eastern Pacific Begins	22
PACIFIC ENVIRONMENTAL GROUP	26
Multispecies Model of the California Current Pelagic Species Under Development	26
TIBURON LABORATORY	27
Techniques to Analyze Groundfish Data Developed	27
Marketing of Shortbelly Rockfish Planned	28
Rock Crab Meat Yield Investigated	28
MISCELLANEOUS	30
Honors and Awards, Seminars, Meetings and Travel, Visitors, Public Relations, Press Releases and Personnel	30

NOAA/NMFS

TO OUR READERS:

In the future, to cancel delivery of the Southwest Fisheries Center (SWFC) Monthly Report, or to change the delivery address, please notify by writing, Editor, Southwest Fisheries Center, P.O. Box 271, La Jolla, California 92038.

Izadore Barrett, Director, SWFC
John F. Carr, Deputy Director, SWFC

THIS REPORT DOES NOT CONSTITUTE PUBLICATION AND IS FOR INFORMATION ONLY.

SOUTHWEST FISHERIES CENTER
LA JOLLA, CALIFORNIA

HONOLULU LABORATORY
LA JOLLA LABORATORY
TIBURON LABORATORY
PACIFIC ENVIRONMENTAL GROUP

MONTHLY REPORT - JANUARY 1979

PUBLICATIONS

Published

Whipple, J.A., T.G. Yocom, P.E. Benville, D.R. Smart, M.H. Cohen, and M. E. Ture. Transport, retention, and effects of the water-soluble fraction of Cook Inlet crude oil in experimental food chains (RU 389). NOAA Tech. Mem. ERL OCSEAP-1. p. 106-129.

This preliminary report on research performed by Tiburon's Laboratory Physiology Investigations Program under the Outer Continental Shelf Environmental Assessment Program includes descriptions of experimental designs, techniques, and a summary of results to the date published.

The basic objectives of this study were to determine the accumulation and passage of petroleum constituents in selected experimental marine food chains and the effects of exposure to the water-soluble fraction (WSF) of Cook Inlet crude oil on the organisms. This report includes results of experiments with starry flounder (Platichthys stellatus) and littleneck clams (Protothaca staminea and Tapes semidecussata).

Preliminary results were as follows: Flounder (non-spawning) accumulated low-boiling-point compounds much more rapidly through the water column than they did through molluscan food items. Monocyclic-aromatic hydrocarbons were either metabolized into other compounds during digestive uptake or were not accumulated through that pathway. Concentrations of monocyclic aromatics in flounder liver reached maximum within a week, yet concentrations of alkyl cyclohexanes increased throughout the exposure period. The cyclohexanes were below detectable levels in the water column and in control tissue samples. Starry flounder in pre-spawning condition accumulated monocyclic aromatics in ovaries and liver from 100 to 1,000 times the concentrations in water.

Concentrations of petroleum hydrocarbons in Tapes did not reach maximum levels in two-week exposures. Further analyses are needed to determine maximum levels reached in Protothaca tissues. At low concentrations of WSF, long-term exposures are probably necessary to reach maximum tissue accumulation; in littleneck clams, maximum tissue concentrations may be independent of water concentration. For identical exposures, Tapes accumulated aromatic hydrocarbons to concentrations three times that found in Protothaca. Sublethal effects resulting from this differential uptake could have consequences to population structure and distribution of these clam species, since the species occupy similar habitats and are often sympatric.

Hobson, E.S. Aggregating as a defense against predators in aquatic and terrestrial environments. In Reese, E.S. and F.J. Lighter (Editors). Contrasts in behavior. p. 219-235. Wiley-Interscience.

Aggregations are widely thought to offer protection against predators, but the basis of this protection has been a controversial topic. At least part of the controversy probably stems from the fact that the advantage differs with circumstances. Selection pressures are very different, for example, between aquatic and terrestrial habitats. On land, where animals often interact over considerable distances, the major advantage may be earlier detection of predators because there are more sensory receptors in a group. Underwater, however, where visual ranges are short, prey often must tolerate a charging predator in their midst, and here the benefits of aggregating may be in confusing the predator by presenting multiple targets.

HONOLULU LABORATORY

RESOURCE ASSESSMENT AND DEVELOPMENT INVESTIGATIONS

Cooperative Study on Decison Making Processes Begins

Dr. Roy Mendelssohn, Operations Research Analyst, worked with Dr. Edward J. Sondik of the National Institute of Health to develop several efficient algorithms for calculating how frequently a managed fish population that varies randomly should be sampled.

Previous work has demonstrated that when a fishery has a random component, good policies have a "feedback" aspect to them. Fishery decisions in any given year are based on population size. A policy is like a contingency plan--if the observed population size is x, then do y. The present anchovy plan which was developed for the Pacific Fishery Management Council is an example of this type of plan. However, obtaining a population estimate can be expensive, more expensive than the increased benefits derived from surveying the population merit.

The algorithm developed by Mendelssohn and Sondik allows them to calculate a contingency plan for a gap between surveys of more than a year. For a gap of two years between surveys, the algorithm describes what action should be taken during the two years if a given population size is observed from the survey. The algorithm finds the two-year contingency plan that gives the largest expected return from all such plans and compares the decreased survey costs with the loss in value of this plan compared to a plan with yearly survey. The algorithm can similarly find contingency plans for gaps of three, four, five, or more years without a survey.

Mendelssohn and Sondik have applied the algorithm to several existing models of randomly varying fisheries. In one case, they found that an optimal plan involving a survey every other year had just about the same expected value as an optimal plan assuming surveying every year. The decrease in value was so small that as long as the cost of the survey was greater than $22,100, it was preferable not to survey every year. Similarly, as long as the cost of the survey was greater than $30,500, going three years without a survey was preferable to surveying every year.

This research is directed primarily toward determining cost-effective management for fisheries. Other possible extensions and uses for the algorithm are presently being researched. In addition to its applications in fisheries management, the algorithm has applicatins in medical surveys, machine inspection in business, and in a more theoretical vein, in the literature on the "cost of information" in economics and decision sciences.

Work Continues on Stock Assessment Studies

Dr. Jerry Wetherall, Leader of the Fishery Management Research Task, reported that researchers in the Task were involved in various activities related to stock assessment studies. Wetherall and Mathematician Marian Yong are preparing estimates of tuna catch and effort by bait boats and longliners operating within the 200-mile zone of the Federated States of Micronesia.

Dr. Wetherall also developed equations for estimating total mortality rates which are free of tag shedding bias, using information from double tagging experiments. This procedure is one of a number of alternative techniques being evaluated in a manuscript under preparation by Wetherall and Yong for publication in the Fishery Bulletin.

Fletcher Riggs, Fishery Biologist, is preparing a series of computer programs which will be used in analyzing tuna catch and effort statistics for the June tuna stock assessment workshop. The programs are designed to 1) set up, sort, and structure data files for efficient access, 2) create distribution plots of catch-per-unit-effort (CPUE), effort, and other key variables under user-specified conditions, and 3) generate estimates of stock abundance indices and other parameters for input to generalized production models. In connection with the stock abundance indices, Wetherall is preparing an administrative report outlining the equations to be used, including variance estimators. These will permit proper statistical weighing of abundance indices when production models are fit to the historical catch and effort records.

Howard Yoshida, Fishery Biologist, completed a bibliography of selected references on fishery development and stock assessment of tunas and billfishes

in the Pacific Tuna Development Foundation (PTDF) area of interest. The bibliography is for the use of PTDF officials in preparation for a PTDF meeting to discuss a master plan for fishery development.

Study on Food Habits of Seabirds Begun

Thomas Hida, Fishery Biologist, reported that work was started in examining material regurgitated by seabirds. This is part of a study on the diet of seabirds which is being conducted jointly with personnel in the U.S. Fish and Wildlife Service who are collecting the regurgitated material for study. The purpose of the study is to determine the food habits of various species of seabirds and their effect on the resources of fishes also used as food by tunas and other important pelagic species. The table below shows the organisms identified to date from several species of seabirds.

Bird species	Regurgitated material
Red-tailed tropicbird, *Phaethon rubicauda*	*Ranzania laevis*, *Corphaena* sp., * *Decapterus* sp.,* flyingfishes
Blue-faced, masked, or white booby, *Sula dactylatra*	*Decapterus* sp.,* *Oxyporhamphus micropterus*, *Exocoetus volitans*, *Katsuwonus pelamis*, *Coryphaena equiselis*, squid
Brown booby, *S. leucogaster*	*Parexocoetus brachypterus*
Great frigatebird, *Fregata minor*	*Ranzania laevis*, squid, flyingfishes

*Tentative identification.

Fish Aggregating Buoys Lost in Winter Storms

Walter Matsumoto, Fishery Biologist, reported that two buoys, "A" off Kewalo Basin and "F" off Kailua-Kona, were reported lost in January. "A" buoy probably was lost during the gale force storm in December. "F" buoy (raft type) was badly damaged during the same storm and attempts to save the anchor line in early January failed. Two buoys are being fabricated to replace the lost buoys. These will be deployed on the *Cromwell's* next cruise scheduled for March 30, 1979. No buoy monitoring trip was made in Janaury due to rough sea conditions during the entire month.

Matsumoto submitted monthly and annual (calendar 1978) reports on the buoy project to PTDF.

Preliminary Analysis Made of Growth Curve of Spiny Lobsters

Part of the research effort of the Survey of Insular Resources Task is to refine the current knowledge of the distribution, abundance, and other life history aspects of spiny lobsters (Panulirus marginatus) in the Northwestern Hawaiian Islands (NWHI). In conjunction with this effort, Richard Uchida, Task Leader, reported that Fishery Biologist James Uchiyama completed a preliminary analysis of the growth of spiny lobsters. The growth curve, based on the progression of modes in spiny lobster length frequencies, assumes a single spawning peak in any given year. Work done by other investigators which indicates that female spiny lobsters reproduce once a year around Midway appears to justify this assumption. However, another study indicates that female lobsters around Oahu reproduce four times a year. Uchiyama's lobster growth curve shows good agreement with results obtained on growth of juvenile spiny lobsters by Hawaii Division of Fish and Game scientists.

Uchida, assisted by Research Assistant Darryl Tagami, continued regression analysis of spiny lobster morphometric data and studies on catch, effort, and distribution of spiny lobsters in NWHI waters.

Research Assistant Victor Honda continued examining lobster pleopods to determine whether external changes in the exoskeleton and internal setae development of the pleopod tip could be used in defining molt stages. The results are inconclusive to date and further studies are planned.

NWHI Study Continues

Other members of the Survey of Insular Resources Task continued work relating to various aspects of the NWHI study. Research Assistants Paul Shiota, Glenn Higashi, Robert Moffitt, and Bert Kikkawa fabricated fish and shrimp traps that will be used in a forthcoming cruise to the NWHI. Research Assistants Jeffrey Sampaga and Jose Enitan continued reading otoliths of pink snapper, Pristipomoides filamentosus and prepared sagittal sections of gindai, Rooseveltia brighami and amberjack, Seriola dumerilii otoliths.

Manuscripts Completed and Reviewed

Reginald Gooding, Fishery Biologist, completed a draft of the manuscript, "Respiration rate and low-oxygen tolerance limits in skipjack tuna, Katsuwonus pelamis," by Gooding and Neill and circulated it for internal review. Gooding also completed a status report of an aerial survey of Hawaiian monk seals and green turtles in NWHI waters, a project proposal for seamount resources survey, and another proposal for documenting the NWHI field survey on 16-mm film. With the assistance of Reseach Assistant Bernard Ito, he also continued to update the field handbook for identifying fishes in the U.S. Fishery Conservation Zone in the central and western Pacific.

Ito also prepared a chemical usage report for the Environmental Protection Agency on water discharge at Kewalo Basin.

Uchida reviewed the second draft of "Hawaiian monk seal critical habitat discussion paper," the first draft of a paper, "Anguillid leptocephali from the eastern Indian Ocean" by Osame Tabeta and Takakazu Ozawa, and an English abstract of the paper, "Population analysis of the common mackerel, Scomber japonicus, based on catch statistics and biological information collected in the western Japan Sea and the East China Sea" by Akira Ouchi and Seiichi Hamasaki.

Uchiyama continued work revising the paper, "Age and growth of skipjack tuna, Katsuwonus pelamis, and yellowfin tuna, Thunnus albacares, as indicated by daily growth increments of sagittae."

January Landings of Skipjack Tuna in Hawaii Below Long-Term Average

The January 1979 Hawaii landings of skipjack tuna were estimated at 90.9 metric tons (MT), which is 136 MT below the landings in January 1978 and 57.1 MT below the 1948-78 long-term average for January.

FISH-ENIVRONMENT INVESTIGATIONS (FEI)

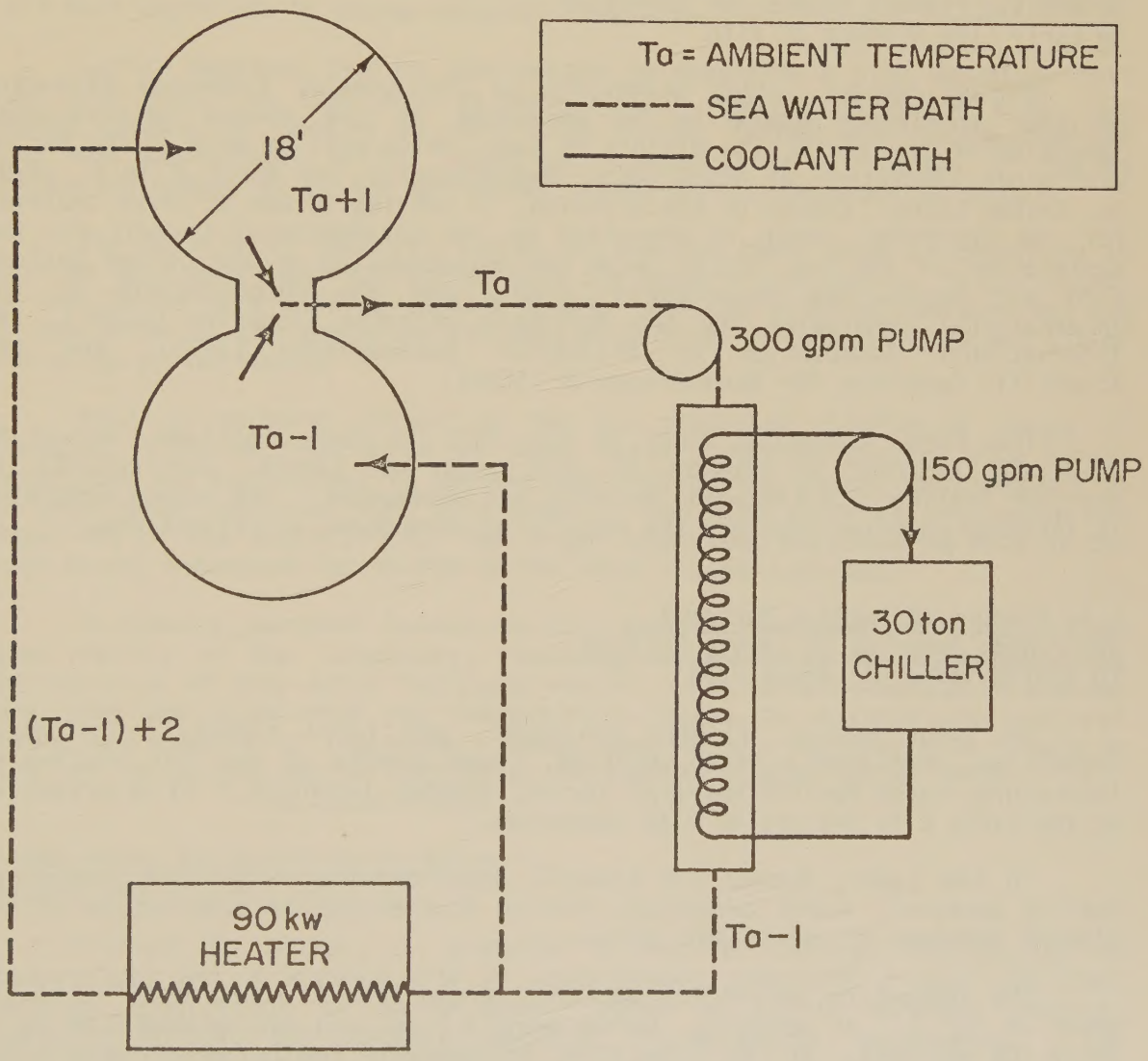
Work Begun on a New Approach to Problem of Determining Temperature Preference in Tunas

A new effort to determine the temperature preference of tunas has been initiated by Dr. Andrew Dizon of the Experimental Ecology of Tunas Task.

Dizon presented a paper, "Thermoregulation in Tunas," at the annual meeting of the American Society of Zoologists in Richmond, Virginia. Ideas generated during discussions with fellow symposium members encouraged a new attack on the problem of determining temperature preference in tunas. Although established testing paradigms for small, freshwater fishes have long been available, the expense of scaling-up the experimental apparatus used for these small fishes to the size required by tunas was discouragingly formidable. Nevertheless, information on temperature preference of tropical tunas is of sufficient importance to warrant the effort.

A design has been completed and construction initiated on a testing tank based on existing temperature preference apparatus, but scaled for the size and continuous-swimming behavior of tunas (see figure). The new two-tank apparatus will use heating and cooling equipment originally purchased in 1973 for the annular thermoregulation tank, the so-called "doughnut tank," which will now be used to study active respiration of forced-swum tunas. The temperature preference experiment will be controlled and monitored by our existing Hewlett-Packard 9825 computer and its associated environmental monitoring gear. The test system has two tanks; one of which is always maintained 2° warmer than the other. When the fish or fish school is positioned on the warmer side, temperature is increased in both tanks but the

2° differential is always maintained. When the tank becomes too warm, the fish or school learns to "shuttle" to the cooler side because they are rewarded immediately by slightly cooler water. The monitoring equipment senses the movement into the cooler tank, and causes the tank complex to slowly cool down. Eventually, the fish will become quite proficient at shuttling from tank to tank to control their temperatures with a great deal of precision.



Coastal Fisheries Resources Division

LARVAL FISHES, COASTAL EAST PACIFIC

Scientists Prepare Papers for Symposium on Early Life History of Fish

During January, eight scientists of the Coastal Fisheries Resources Division completed papers to be presented at the second international Symposium on the Early Life History of Fish, which will be held at the Marine Biological Laboratory at Woods Hole, Massachusetts, on April 2 to 5, 1979. Dr. Reuben Lasker, Leader of the Division, is serving as one of three chairmen for the Symposium, which is organized by the International Council for the Exploration of the Sea (ICES), with the collaboration of the United Nations Food and Agriculture Organization (FAO), and the cosponsorship of the International Commission for the Northwest Atlantic Fisheries (ICNAF), the International Association of Biological Oceanography (IABO), and the Scientific Committee for Ocean Research (SCOR).

The first symposium, held in May 1973 in Oban, Scotland, served to stimulate interest in studies of fish eggs and larvae, particularly in programs dealing with fisheries dynamics and management. The second symposium is intended to bring together the results of subsequent investigations.

Life History of Pacific Mackerel Described; Survival of Larvae Related to Availability of Larger Prey

Dr. John Hunter, Fishery Biologist, and Carol Kimbrell, Biological Technician, completed a paper entitled, "Some aspects of the life history of laboratory-reared Pacific mackerel larvae, Scomber japonicus," to be presented at the Early Life History of Fish Symposium.

In the paper, Hunter and Kimbrell described the early life history of Pacific mackerel, using laboratory rearing studies and an examination of the stomach contents of sea-caught larvae.

The incubation period for mackerel ranged from 33 hours at 23° C to 117 hours at 14° C. At hatching, larvae were 3.1 mm long and weighed 0.04 mg of which 50% was yolk. At 19° C the first incidence of feeding occurred 26 hours after hatching and by 60 hours (age 2.5 days) all larvae were capable of feeding. At this time, larvae were 3.6 mm long, eyes were fully pigmented, and only 10% of the yolk remained. Starvation became irreversible if larvae were not fed before age 4.5 days. At age 5 days, larvae were still capable of feeding but were not able to capture enough prey to survive.

Growth of mackerel larvae is characterized by a relatively slow, almost linear trajectory over the first 10-15 days, during which larvae reached 6-7 mm, followed by a rapid acceleration of growth through metamorphosis at 15 mm.

Growth rates ranged from 0.59 mm/day at 16.8° C to 0.93 mm/day at 22.1° C and had a Q_{10} of 3.0. Mackerel larvae had a relatively high metabolic rate: oxygen consumption of larvae in a Warburg apparatus was 6.13 μl O_2/mg dry weight/hour at 18° C and 11.26 μl O_2/mg dry weight/hour at 22° C.

Cruising speeds of mackerel larvae increased from 1.3 body lengths/second for first-feeding larvae to 3.8 body lengths/second for fish at metamorphosis. At typical cruising speeds, 3 to 5 mm mackerel larvae swam with a high tail beat frequency (30 beats/second) and principally modulated tail beat amplitude to change swimming speed.

Larval mackerel fed on zooplankton by executing a high amplitude tail beat and engulfing food with an open mouth. When they reached 8 mm, 50% became capable of feeding on other fish larvae; larvae were seized from the side and manipulated before ingestion. Cannibalism was common in rearing groups but ceased as larvae approached metamorphosis and began to school.

The ability of mackerel larvae to capture their prey by engulfing it with an open mouth was correlated with the width of the mouth. Fifty percent of the larvae were able to capture a prey when the width of the prey was 85% of the width of the mouth and 95% were able to do so when the prey was 57% of the width of the mouth.

Food of mackerel larvae in the sea consisted chiefly of stages of copepods. The maximum width of foods eaten increased rapidly with larval length and was equilvalent to the maximum width of the mouth; the minimum size of prey eaten increased much more slowly. The mean width of prey eaten was about 40% of the mouth width. The larger organisms, constituting half of the prey eaten, accounted for 85-90% of the total volume consumed.

In summary, mackerel larvae are fast swimming, metabolically active, and grow rapidly in the laboratory, reaching metamorphosis in 16-24 days. The maximum size of prey eaten increases rapidly with larval size but in the sea many prey are eaten that are substantially below the maximum size mackerel larvae are capable of ingesting. These observations indicate that growth or survival in the sea may be limited by the availability of larger prey.

Growth Rates Estimated for Northern Anchovy and Northern Lampfish

Richard C. Methot, a graduate student at Scripps Institution of Oceanography who is working with Dr. John Hunter, completed a paper entitled, "Spatial covariation of daily growth rates of larval northern anchovy, *Engraulis mordax*, and northern lampfish, *Stenobrachius leucopsarus*." The paper will be presented at the Early Life History of Fish Symposium.

In his research Methot determined the growth rates of 248 northern anchovies, *Engraulis mordax*, and 145 northern lampfish, *Stenobrachius leucopsarus*, by measuring the widths of recently deposited daily growth increments in their otoliths. He observed very little variation in growth rate between samples and the correlation in growth rate between species was not significant.

Methot estimated that the mean growth rate of Stenobrachius leucopsarus increased from 0.15 mm per day at a size of 5 mm to 0.25 mm per day at 15 mm. These are the first growth rate estimates for larvae of this species. The mean growth rate of Engraulis mordax larvae larger than 9 mm was 0.50-0.45 mm per day. This is very similar to the growth rate of anchovy reared in the laboratory at the temperatures (15-16.3° C), the temperatures at which these samples were collected.

Larvae of Engraulis mordax and Stenobrachius leucopsarus were abundant off the coast of Oregon in July 1977. Both occurred in 100% of the samples taken at 15° C or warmer.

Studies Suggest that Plankton Predators Affect Anchovy Recruitment

In a paper entitled, "The relation between the distribution of zooplankton predators and anchovy larvae," prepared for the Early Life History of Fish Symposium, Fishery Research Biologist Dr. Angeles Alvariño compared the distribution of anchovy larvae, Engraulis mordax, with concentrations of predator species: Chaetognatha, Siphonophorae, Chondrophorae, Medusae and Ctenophora. The data were obtained from the study of plankton collections of the monthly California Cooperative Oceanic Fisheries Investigations (CalCOFI) cruises of 1954, 1956, and 1958, years selected because they were respectively "slightly colder," "colder," and "warmer" than the long-term average for the California Current.

The analyses of the samples also provided information on the abundance of other zooplankters appearing in large amounts in the collections, copepods, euphausiids, decapod larvae, pteropods, heterods, polychaetes, salps, doliolids, pryosomes. The plankton samples analyzed (more than 2,000) were obtained with 1-meter net oblique tows, from about 140 m depth or less to the surface.

Alvariño observed that highest concentrations of predators corresponded to low or zero anchovy larvae population and vice versa. The large Chaetognatha, S. enflata, S. hexaptera and S. scrippsae, were inversely related to anchovy larvae concentration. Physonectae, prayidae and hippopodiidae siphonophorae, due to their anatomical features and behavior, which were able to cover relatively large volumes of water, acting like living nets, usually coincided with an absence of anchovy larvae. Sagitta decipens, a chaetognath from the mesopelagic domain (below 200 m depth), when observed at the epipelagic layers, is an indicator of upwelling. The presence of S. decipiens usually coincided with the absence of anchovy larvae.

The plankton assemblages at locations with no anchovy and greatest number of larvae indicated that during 1954 and 1958 the absence of anchovy coincided in about 60% of the cases with huge quantities of salps; in other instances with decapod larvae, doliolids, polychaetes, pteropods, heterpods and euphausiids. During 1956, the absence of anchovy larvae concurred in more than 63% of cases with abundance of pyrosomes, or megalopa larvae, salps and Euphausia pacifica in the other locations. During 1954, 1956 and 1958, the greatest number of anchovy larvae coincided with enormous aggregations of copepods in about 80% of the locations, and with euphausiids and pteropods in the remainder of the stations. This illustrates that predatory pressure is weaker when there is an abundance of copepods.

Anchovy larvae appeared abundant at locations where low volumes of water were strained during the haul because of clogging of the net due probably to abundance of phytoplankton. This characteristic occurred twice the number of times in locations with high concentrations than in locations where anchovies were absent.

These studies suggest that plankton predators in the spawning and larval developing areas may at times affect successful recruitment by reducing the larval anchovy population significantly.

Patches of Starving Anchovy Larvae Surveyed

Charles P. O'Connell, Fishery Biologist, completed a paper entitled, "Estimation by histological methods of the percent of starving northern anchovy larvae in the sea." The paper, which will be presented at the Early Life History of Fish Symposium, describes the results of a survey taken to estimate the proportion of larvae of the northern anchovy, Engraulis mordax, that were in starving condition.

Sixty-four special net tows were taken over the Southern California Bight in March 1977. The number of larvae in the tows varied from 0 to about 400. Three hundred and eighteen larvae, about 6 per tow, were sectioned and examined with the light microscope. Twenty-six specimens, ranging from 2.5 to 10 mm standard length, were identified as emaciated from anomalies of the trunk musculature and the digestive tract. The anomalies were similar to those previously seen in larvae that were starved in the laboratory. Some of the emaciated larve occurred as isolated cases from widely scattered locations, but three-quarters of them were from a few tows in one nearshore area, indicating the presence of "patches" of starving larvae. Temperature data suggests that these patches were associated with fluctuating environmental conditions. The unsectioned larvae from the tows through patches of starving larvae were easily distinguished from those of other tows by gross microscope examination, suggesting that patches can be recognized without resorting to histological methods.

The samples indicate that there were 8% $\pm$ 3% starving larvae in the population. The percentage of starving larvae is not a measure of mortality as such, but if mortality is some function of the percentage observed to be starving, the percentage could be an indicator of ultimate year class recruitment. The 1977 year class, which has now entered the fishery, is moderate in size compared to other recent year classes. Documentation of larval condition and subsequent recruitment for a few additional years should indicate whether the "starvation ratio" will be a reliable early estimator of year class strength.

Model Describing Anchovy Egg Distribution Developed

Dr. Daniel Weihs, Research Associate, began work on a model describing the distribution of anchovy eggs in spawning areas. This work is motivated by the fact that approximately 1/3 of all sampling tows yield positive results, with a rather unique non-Poisson distribution.

Weihs bases his model on the hypothesis that eggs are laid while the fish schools are moving. The model indicates that the initial configuration of a patch is cylindrical, with the long axis indicating the school's trajectory. Diffusion causes time dependent spread so that at any given time the egg trail has the shape of a truncated cone, with the large base containing the earliest eggs. Preliminary checks seem to indicate good correlation between the theoretical predictions and field data.

Weihs also completed a paper entitled, "Swimming of yolk-sac anchovy (Engraulis mordax) as a respiratory mechanism," based on research reported in the November/December monthly. The paper will be presented at the Early Life History of Fish Symposium.

Survival of Anchovy Larvae Related to Patchy Food Distribution

In a paper entitled "Microscale plankton patchiness and feeding of the larval anchovy (Engraulis mordax Girard)," completed for the Early Life History of Fish Symposium, Oceanographer R.W. Owen notes that concentrations of food available to first-feeding northern anchovy larvae, as measured by plankton net sampling, always seems too low for growth and survival.

Owen indicates that conventional sampling with plankton nets, which integrates over considerable depths and large volumes of water, has no relation to the search pattern and tiny volume sampled by a single larvae. Sets of plankton samples obtained recently at 20 cm intervals under a variety of locations and conditions in California coastal waters exhibit a degree of variation which shows that larvae may commonly encounter suitable food in concentrated patches of less than two meter extent.

Survival of larvae depends on the existence of such microstructure, which may be attenuated or obliterated by any of several mixing processes. Larval survival also depends on food availability: even where microscale patches occur, food organisms are unavailable if they are associated with marine snow rather than free-living.

Larvae Raised Under Diverse Feeding Regimes Distinguished by Comparison of Morphometric Criteria

Fluctuations in recruitment of young fish to a fish stock may be the result of mortality during the larval stage. Since starvation is believed to be one of the principal causes of larval mortality, fishery scientists could probably make a better prediction of recruitment if they could recognize starving larvae easily in ichthyoplankton survey collections. In the past, differences in the size and form of body parts have been used to distinguish between starving larvae and feeding larvae. Body parts are relatively easy to measure. If these morphometric criteria can be shown to be sensitive enough to indicate larval fish condition, the technique could be applied routinely to assess fish condition in larval fish surveys.

Fishery Biologist Gail Theilacker recently completed a paper entitled, "Effect of feeding and egg size on the morphology of jack mackerel, Trachurus symmetricus, larvae," which describes the results of her research applying morphometric techniques to assessing the condition of jack mackerel larvae.

Theilacker used a multivariate statistical analysis to index larval fish condition. The criteria used in the analysis were based on morphometric characteristics of larvae hatched from large and small eggs and raised under conditions in which the following were varied: availability of food, type of food (wild vs. laboratory cultured plankton), time of feeding (delayed by one day or two days), and density of food. The larvae were divided into seven categories, according to their feeding regime and egg size. Using the multivariate morphometric technique, Theilacker classified larvae in each controlled feeding group according to probably feeding history. The analysis allowed her to differentiate between well-fed, average-growing larvae and feeding larvae of the same size that had been growing more slowly. Larvae that grew slowly included ones that had hatched from smaller eggs, and ones that had been fed for two or more days after one day of starvation.

Tissue degeneration caused by 1 day of starvation showed complete regeneration in 50% of the larvae after feeding 1 day and in 89% of the larvae after feeding 2 days. Tissue regeneration was seldom complete in larvae starved two days before feeding. Fed larvae that hatched from large and small eggs could be differentiated using the morphometric technique, though they could not be distinguished through histological examination. Hence, the morphometric indexing was more sensitive than the histological analysis. Morphometric analysis has an additional advantage in that criteria for classification of individual larval condition using this technique take much less time to determine than histological criteria.

Fluctuations in Anchovy Population Investigated; Partial Success of 1978 Year Class Predicted

Egg and larva surveys indicate that the population of northern anchovy, Engraulis mordax, off the California coast has declined over the past three years, as a consequence of two very poor year classes, reported Dr. Reuben Lasker, Leader of the Coastal Fisheries Resources Division.

The Anchovy Fishery Management Plan, adopted by the Pacific Fishery Management Council as mandated by the Fishery Conservation and Management Act of 1976, provides a formula for setting an annual optimum catch of the northern anchovy by U.S. and foreign fishermen off the California coast. In connection with the plan, spawning biomass estimates for anchovy were made, using data from the last two triennial surveys (1975 and 1978) for fish eggs and larvae performed by the California Cooperative Oceanic Fisheries Investigation (CalCOFI). These surveys showed a significant decline in the total anchovy spawning biomass over the three-year period: from 3.3 million metric tons to 1.2 million metric tons. Natural variability in the size of the anchovy central stock is well-documented; spawning stock size was last estimated to be 1.2 million metric tons in 1961 (PFMC, 1978). Information obtained from the fishery showed that the 1974 and 1975 year classes were very poor and contributed to the decline in the anchovy population, but that the 1976 year class was better than average.

Until 1978, fishing on the anchovy was regulated by the Fish and Game Commission of the State of Califoria, and was held to a modest take, approximately 163,000 tons in 1975. With the advent of an unregulated Mexican fishery on the same stock south of the border, the 1977 catch totalled approximately 257,000 tons, with Mexican fishermen taking 157,000 tons and U.S. fishermen taking 100,000 tons. So far, Mexico has not adopted an anchovy management plan and fishes this stock without restriction.

The combined effect of heavy fishing on spawning stock and a succession of poor year classes has depressed other clupeoid stocks (Murphy, 1977). Whether a 257,000-ton fishery can be considered "heavy fishing" on this stock is unknown. However, if the Anchovy Management Plan had been in effect in 1977 and if the spawning biomass had been known to be low, the plan would have restricted fishing. The Plan currently provides that an annual estimate of anchovy biomass be made.

Fishing on a stock can be regulated, but the causes of natural fluctuations in population size remain relatively unknown, despite current research into the so-called "stock and recruitment problem." Basically, the "stock and recruitment problem" involves answering two questions: what are the major factors controlling reproduction and larval survival? and what is the impact of reduced stock size on the strength of future recruitment into a year class?

Studies at the Southwest Fisheries Center have shown that food of first-feeding larval anchovies becomes a limiting factor when storms (e.g. 1978) or drastic upwellings (e.g. 1975) dilute food aggregations. A complication is that often nutritionally inadequate larval fish food can be overwhelmingly dominant in the larva's environment, despite otherwise favorable oceanographic conditions, as occurred in 1975 (Lasker 1975, 1978; Scura & Jerde, 1977). This suggests that several conditions must be met for survival of first-feeding larvae; stability of the water column and aggregation of nutritionally adequate food must coincide with the production of anchovy larvae in space and time.

CalCOFI surveys during the anchovy spawning seasons of 1975 and 1978 and a special cruise in 1976 provided data supporting the hypothesis that the upper mixed layer of the ocean must be in a stable (non-turbulent) state for survival of enough larval anchovy to insure the production of a good year class. How long these conditions must prevail is an area of continued study.

The drought year, 1976, was characterized by stable conditions in the Southern California Bight and produced the best of the last sixteen anchovy year classes; 1975 produced the worst. Partial success of the anchovy year class in 1978 is predicted by Lasker, based on the onset of stable conditions and food aggregations in the latter part of the spawning season when spawning was the heaviest of the season. Documentation of these results will appear in a paper entitled "Factors contributing to variable recruitment of the Northern anchovy (Engraulis mordax) in the California Current: contrasting years 1975 through 1978," by Dr. Lasker. This paper will be Lasker's contribution to the Early Life History of Fish Symposium to be held in Woods Hole, Massachusetts, April 2 to 7.

ALBACORE FISHERIES INVESTIGATIONS

Manuscripts Completed on Blood Volume and Blood Cell Types in Tunas

During January, Dr. R. Michael Laurs, Leader of the Albacore Fisheries Investigation, worked on manuscripts dealing with albacore physiology studies. He completed a draft of a manuscript on blood volume determination in albacore, which will be submitted to Science for publication after review by co-authors. The blood volume of albacore was determined to be between 8 and 20 percent of the weight of the fish and to have an inverse relationship to weight. These estimates of blood volume by weight for albacore tuna are appreciably higher than those that have been reported fo other teleostean fishes. As the albacore tuna is classified phylogenetically as a higher teleost, the data are not consistent with the hypothesis generally accepted in fish biology that large blood volume is a primitive characteristic among the fishes. Rather, the authors hypothesize that the blood volume in fishes is dependent on the ecological requirements of a species, with fast swimming fishes having larger blood volumes.

Laurs also worked on a manuscript with a former UCSD School of Medicine hematologist on observations of hematological parameters of albacore and skipjack tunas. Morphological descriptions and cell measurements of albacore and skipjack blood cell types are given in the paper. This is a significant contribution to tuna biology, as the only other description of blood cell types for any of the tunas is one for Atlantic bluefin. Erythrocytic parameters are also discussed in the manuscript including red blood cell counts, hemoglobins, pack cell volumes, reticulocyte counts and cell indices. In addition, differential white blood cell and thrombocyte counts are given and discussed. The authors intend to submit the paper to the journal, Fish Biology, for publication.

Albacore Data Keypunched and Analyzed

Fishery Biologists T. Majors and R. Nishimoto compiled and summarized albacore length frequency data collected by the States of Washington, Oregon and California during 1972-1978. The data were separated by time periods, location of catch and fishing gear, and keypunched on data cards in a format that can be used in population studies of the North Pacific albacore.

R. Nishimoto also compiled and analyzed data gathered during joint NMFS-American Fishermen's Research Fondation research and scouting cruises on albacore in the eastern North Pacific for 1977 and 1978, and fishery exploration and research operations conductd by U.S. jigboats in 1978 on albacore in the western Pacific.

New Computer Program Developed for Processing Satellite Data

Lt. David McConaghy of the NOAA Corps reports that a new computer program has been developed for the satellite-derived sea surface temperature program series. The new program (SST CELL FILE) retrieves temperatures from a given satellite digital data field, based on latitude and longitude, and creates a file (CELL FILE) containing records of geographic position and corresponding temperature. This program will facilitate the comparison of NOAA-5 satellite derived sea surface temperatures with other data sources.

Oceanography of North Pacific Transition Zone Described

R. Lynn, Oceanographer, is preparing the text of a manuscript on the oceanography of the Transition Zone in the eastern North Pacific and the subarctic and subtropical ocean fronts which form its boundaries. The manuscript is based on hydrographic data collected during six albacore-oceanography cruises conducted during each June of the years 1972 through 1977. Albacore are associated with these mid-ocean features and their migration, availability and relative abundance is influenced by the degree of development of the fronts. Analyses of oceanographic data from these surveys demonstrate that the ocean fronts are major features of the upper 200 meters of the ocean and that the frontal region has considerable dynamic activity with flows and counterflows. Initial calculations of transport, which integrates the velocity over depth and across broad regions, shows that there is a net eastward flow about the fronts but not within the Transition Zone. These calculations are sensitive to the choice of the grouping of stations and will be compared and checked with other data. Meridional hydrographic sections taken by Scripps Institution of Oceanography in other seasons are being used for comparison.

Lynn's manuscript also describes features of the ocean fronts which appear to be characteristic to longitudes east of 150° W, including large-scale interleaving of water masses along the fronts, and large-scale meanders of the subarctic front as its position decreases in latitude in an eastward direction. In addition, the paper discusses large interannual variation in frontal development.

MULTISPECIES TAXONOMY

Olive Rockfish Larvae and White Croaker Larvae Reared in Laboratory

The staff of the fish rearing project--which has as its goal the identification of previously unidentified eggs and larvae fond in samples taken on California Cooperative Oceanic Fisheries Investigation (CalCOFI) cruises--began work with two more species this month: the olive rockfish, *Sebastes serranoides*, and the white croaker, *Genyonemus lineatus*.

On January 18, Fishery Biologist Bob Counts and Biological Technician Bill Flerx obtained olive rockfish larvae from two pregnant females whose young were about ready to be spawned. Rockfish have internal fertilization of their eggs, and carry them internally until they hatch as larvae and are extruded. The larvae obtained by Counts and Flerx were reared for 15 days, during which period they developed the pigment pattern typical for this species.

On January 5, eggs of the white croaker, obtained in plankton hauls off La Jolla, were started in rearing tanks by Fishery Biologist John Butler. A number of larvae hatched and are still being reared. The white croaker will be the sixth species of croaker successfully reared by Butler, working with Dr. H.G. Moser, Leader of the Multispecies Taxonomy Program. Specimens of the larvae are preserved at intervals for use in describing and illustrating larval series.

Gut Content Study of Fish Larvae Initiated

A long-term study of the feeding habits of fish larvae in the California Current was undertaken by Fishery Biologist Barbara Sumida MacCall and Moser, with preliminary dissections on larvae of the hake, Merluccius productus. Of 14 larvae examined, only four had empty stomachs, two of these being yolk-sac larvae. Copepods--primarily Oithona and Clausocalanus species--comprised the bulk of the stomach contents. Sumida MacCall is working with Dr. Abraham Fleminger of Scripps Institution of Oceanography to establish a reference collection of the common copepods of the CalCOFI region to aid her in further identification of copepods fragments and naupliar and copepodid stages found in the guts of fish larvae.

COMMERCIAL & RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT

Draft Jack Mackerel Plan Presented to Council

The first draft of the jack mackerel management plan was reviewed by the Pacific Fishery Management Council and its Scientific and Statistical Committee (SSC) during the January 10-12 meeting in San Diego.

The SSC noted that some revisions will be necessary and suggested that the team reconsider its use of the term "quota" as applied to domestic fisheries. The intent of the plan is to accommodate expansion rather than to restrict the fishery and the lower level of any possible harvest options should be set sufficiently high so as to permit expansion.

The Plan will be revised for reconsideration by the Council at its March meeting in Eureka. The revision will include a new set of mortality estimates which enter the analysis of potential yield. Potential yield ranges from 107 to 236 thousand tons, depending upon assumed mortality rates. Optimum yield will be chosen by the Council from options ranging from 60 to 100 thousand tons.

Industry Economist Jane McMillan, Fishery Biologist Gary Stauffer and Alec MacCall of the California Department of Fish and Game met with the jack mackerel advisory sub-panel in Long Beach on January 30 to discuss the revisions to the Plan and to accept further suggestions. An environmental impact analysis was written for the jack mackerel plan by McMillan.

Cooperative Cruises Scheduled to Begin

During January Fishery Biologist Gary Stauffer continued to devote substantial time to the arrangements for planned cooperative research cruises on foreign vessels. The Soviet vessel, Tikhookeansky, is expected to arrive in Long Beach on February 8. Bob Counts and Bill Flerx will be aboard the vessel during its 30-day ichthyoplankton survey. Arrival of the Spanish squid trawler, Freire-Lopez, in San Diego is expected on February 13. Sus Kato, Leader of the Fisheries Development Investigation, and H. Moser, Leader of the Multispecies Taxonomy Program, are scheduled to participate on the first leg of the squid survey.

No Significant Changes Proposed in Public Hearing on Anchovy Plan

A public hearing on the proposed amendments to the anchovy plan was held by the Pacific Fisheries Management Council in San Diego on the evening of January 12. Dan Huppert, Leader of the Commercial and Recreational Fisheries Research for Management Program, represented the SWFC on the hearing panel, and Svein Fougner represented the Regional Office. The turnout was very light, as expected, due to the technical nature of the proposed changes. Several sportfishing representatives were present to give testimony, and one commercial albacore fisherman was present. No significant changes to the proposed amendments were suggested by the public.

Recreational Partyboat Survey Continues

Dan Huppert and Economist Cynthia Thomson have received data from the first group of partyboat surveys from the contractor, Center for Natural Areas, Inc. Responses from on-board passenger survey forms, on-board skipper survey forms, and follow-up telephone questions are contained on a single computer tape. The data will be used in statistical examination of several recreational evaluation models. A second group of surveys is scheduled for February.

SURVEY SYSTEMS DEVELOPMENT AND EVALUATION

Meeting Held on Data Systems

During the first week in January, Dr. H. Moser and Dr. Paul E. Smith, Leader of the Survey Systems Development and Evaluation Program, hosted a group from Southern California Edison, Los Angeles County Museum, and University of Southern California who are interested in merging environmental

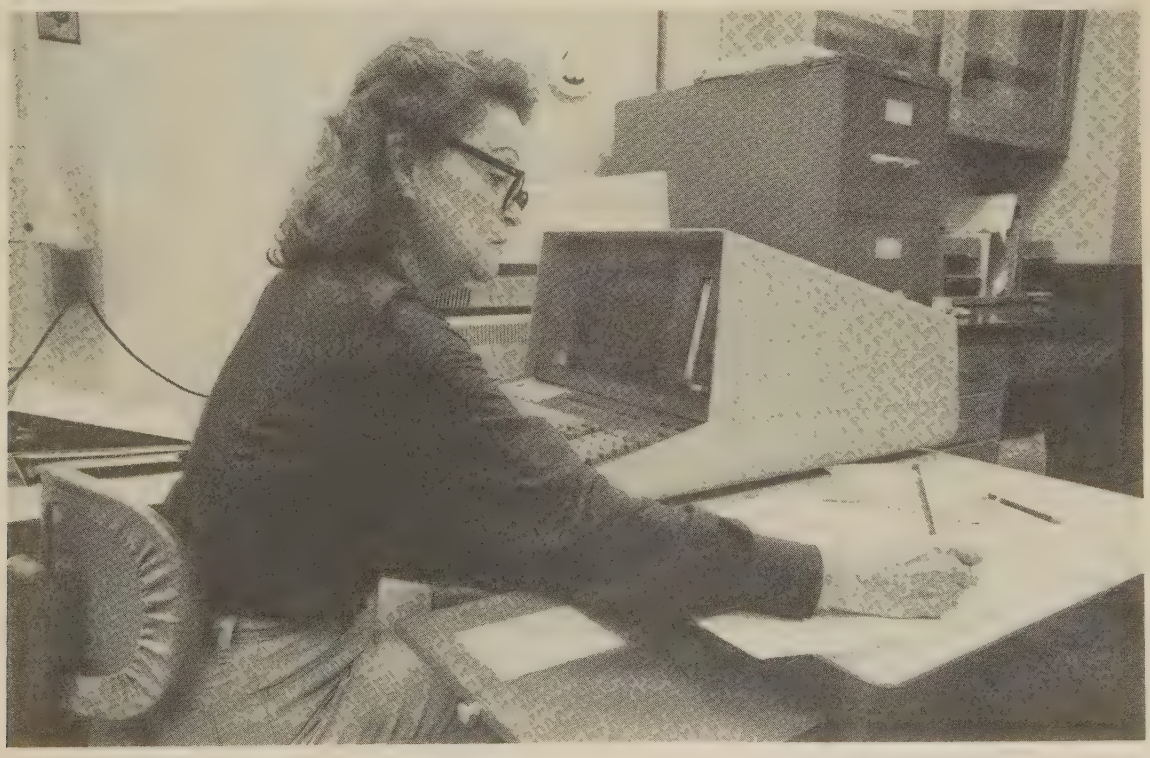
impact data concerning fishes with the CalCOFI data time series. Moser and Smith explained the rationale of the MIDAS (Moser Identifier Data Acquisition System) data system development and demonstrated subsystems under development such as geographic mapping, tabular results, and the modified National Oceanographic Data Service (NODC) list of fish orders, families, genera, and species.

Attendees included Dr. Stowe, research scientist with Southern California Edison (SCE); Dr. Kawashima, SCE research scientist; Dr. Lavenberg, Curator of Fish. L.A. County Museum; Dr. Brewer, research scientist, University of Southern California (USC); and Dr. McGowan, research associate, USC. Also participating in the discussions were James Zweifel, mathematician; James Thrailkill, CalCOFI data collection and management; Richard Charter, CalCOFI data manager; and Chuck Oliver, marine mammal program data manager; all of the La Jolla Laboratory of the Southwest Fisheries Center.

The discussions ended with an agreement to collect data with the same techniques at sea where possible and to file and format data in compatible forms so that data can be merged for fisheries and environmental impact studies.

Improvements in Data Processing at the La Jolla Laboratory

A new minicomputer system at the La Jolla Laboratory lets laboratory technicians involved in plankton sorting to enter their data directly into computer files and allows rapid access to new data before it enters the data base. Here, Laboratory Technician Mary Farrell enters data from a plankton sample that she has sorted, including the location, time and cruise from which the sample was taken, and the contents of the sample.



Sakagawa Named Chief of Oceanic Fisheries Resources Division

Dr. Gary T. Sakagawa, Leader of the Tuna Resources Program, has been named as the new Chief of the Oceanic Fisheries Resources Division at the Center.

As Chief of the Oceanic Division, Dr. Sakagawa will have major responsibilities for the direction and conduct of the Center's research programs on tunas, billfishes, and tuna/porpoise interactions in the purse seine fishery in the eastern tropical Pacific, and for advice on the development of U.S. tuna fishery policy.

Dr. Sakagawa began his career in Hawaii with the then U.S. Bureau of Commerical Fisheries in 1963, following his graduation from the University of Hawaii. He also was employed by the Bureau's Great Lakes Laboratory in Ann Arbor, Michigan as a Fishery Aid while attending graduate school at the University of Michigan from which he received a M.S. degree in 1967. In 1972 he was granted a Ph.D. from the University of Washington's College of Fisheries.

Dr. Sakagawa, whose principal research interest is the population dynamics of tunas and tuna-like fishes, came to the Southwest Fisheries Center in 1971 and has occupied the position of Leader of the Tuna Resources Program at the La Jolla Laboratory since 1977. He serves as scientific advisor to the U.S. delegation to the annual meetings of the International Commission for the Conservation of Atlantic Tunas and of the Inter-American Tropical Tuna Commission and his advice is frequently sought by outside agencies on population dynamics of fishes.

In commenting on the appointment, Center Director Izadore Barrett said, "I am pleased that we have been able to fill this important job with a fisheries scientist of Dr. Sakagawa's calibre. His talents and wide experience are a major assest in developing solutions to U.S. fisheries problems."

Dr. Sakagawa is a member of the American Fisheries Society, American Institute of Fishery Research Biologists and Sigma Xi honorary scientific fraternity. He is the author of more than 20 scientific papers.

He is married to Dr. Ellen A. Miyashiro, a practicing dentist; they have two young daughters, Bryn and Tamara.

MARINE MAMMAL BIOLOGY AND TECHNOLOGY PROGRAM

Computer Simulation of Purse Seining Operation Being Developed

James Coe, Leader of the Marine Mammal Technology Project, reported the completion of Phase I of a contract begun by Scientific Applications Inc. (SAI) last September to develop mathematical functions for a computer program to simulate the tuna purse seining process. The computer program will be used as a relatively inexpensive analytical tool to improve gear performance and reduce porpoise mortality.

Dr. Tom Delmer, SAI's principal investigator for this project, presented a seminar describing the problems, methods, and results of Phase I to SWFC scientific staff on January 26. Phase II of the project calls for the construction and operation of the computer simulation to study problems associated with gear deployment and retrieval. Phase III will involve applying what is learned to real gear operations.

Papers on Odontocete-Aging Conference Prepared for Publication

The presented papers and workshop report of the International Conference on Determining Age of Odontocete Cetaceans, held at the SWFC's La Jolla Laboratory last September, are being edited by Dr. William Perrin, Leader of the Marine Mammal Biology and Technology Program, and Wildlife Biologist Albert Myrick, Jr., in preparation for publication by the International Whaling Commission in late 1979. The published volume will include papers dealing with mechanisms of layering, structural analysis of layered tissues, calibration of layering rates, preparation techniques, age and growth parameters in life history studies, and statistical models. The workshop report will present an up-to-date review of laboratory preparations and analytical procedures for determining ages of odontocetes of most taxa, and will offer recommendations on terminology, standard techniques, and new approaches to problems.

SWFC Staff Members Attend Hawaiian Meeting on Alternative Fishing Methods

Dr. William Perrin and Fishery Biologists Warren Stuntz and James Coe attended a one-day meeting at the Honolulu Laboratory on January 18 to discuss possibilities of cooperative research on alternative fishing methods with representatives of the Honolulu Laboratory, Hubbs' Sea World Research Institute, University of Hawaii, and San Diego State University.

A number of research projects were considered, including the following: the design and deployment of fish-aggregating buoys and fish-monitoring devices; development and packaging of odoriferous attractants; the experimental use of a sonar sonabuoy for identifying species of fish by the sounds they emit; laboratory and field experiments, including radio tracking, to study the tuna-porpoise bond and behavior in the wild and in captivity.

Agreements were reached to cooperate on several research projects during Fiscal Years 1979, 1980 and perhaps 1981.

Satellite-linked Porpoise Tracking System to be Tested

Jackie Jennings, Leader of the Porpoise Tagging Project, reported that after delays caused by technical problems all is in readiness to test a satellite-linked radio transmitter system using a free-swimming captive bottle-nosed dolphin (Tursiops). The radio pack will be attached to the back of the animal with a harness and will transmit signals to NASA's NIMBUS-6 satellite now in earth orbit. Tests are scheduled for February 8-14 at Sea Life Park in Hawaii. Successful tests of the system using captive dolphins will lead to the eventual testing of the system on dolphins in the wild.

Workshop Planned on Physiological Effects of Chase and Capture on Dolphins

Dr. Warren Stuntz, Leader of the Porpoise Behavior and Physiology Project, announced plans to host fifteen scientists in the fields of cetology, veterinary medicine, and animal physiology at a workshop to consider the possible physiological and pathological effects of chase and capture on dolphins associated with the tuna purse-seine fishery. In evaluating the problem, the workshop participants will study necropsy reports, histological samples, and serum-chemistry data. The workshop is scheduled for May 1-3 at the La Jolla Laboratory.

MARINE MAMMAL ASSESSMENT AND MONITORING PROGRAM

Survey of Porpoise Populations in the Eastern Pacific Begins

Two NOAA research vessels, the David Starr Jordan and the Townsend Cromwell, left their home ports on January 3 for the eastern tropical Pacific, to begin a two-month survey intended to estimate the present numbers of eastern spinner, spotted, white belly spinner, and common dolphins, the four principal stocks of dolphins incidentally killed in tuna purse seining operations. In conjunction with the vessel survey effort, an aerial survey is being conducted using an amphibious reconnaisance plan, a modified 4-engine PBY aircraft called the Wandering Albatross.

During their cruise, the search effort of the Jordan and the Cromwell is directed both to areas which cannot be sampled by the aircraft and to a more inshore region of historically higher porpoise density. The ships will crisscross the area of ocean from Manzanillo, Mexico to Puntarenas, Costa Rica out to 600 miles from the coast. The 23 flights of the aircraft will cover much of the area surveyed by the research vessels, allowing scientists to compare the estimates of porpoise population density obtained from the ships and from the aircraft.

Differences in population estimates obtained using line transect methods on data gathered by ship and by plane have not, as yet, been explained by theory. A primary purpose of the survey is to gather data that scientists can use to calibrate the differences in effort between the ships and the aircraft.

The results of the survey will be used to improve the population estimates obtained from surveys made in 1974 and 1977, as well as to generate estimates based on 1979 data and to improve procedures for future survey work using vessels alone.

Eastern Tropical Pacific Ecosystem Modelled

On January 22 and 23, Dr. George H. Innis from Utah State University presented the final report on a contract to develop an ecosystem simulation model for the eastrn tropical Pacific Ocean (ETP), the area of ocean bounded by 40° N, 40° S, the coast of the Americas, and 160° W. The model was designed to simulate the changes in biomass and population of various predator prey species as a function of abiotic factors such as nutrient input and temperature changes. Aiding in the presentation at the La Jolla Laboratory were co-workers on the project, Dr. James Haefner and Dr. Charles Fowler, also of Utah State University.

The model subdivided the ETP into 5° by 5° cells. In each cell, the researchers modelled a variety of factors, including the following: water flow rate; thermocline depth; temperature above the thermocline; insolation; nitrogen and phosphorus; forage items such as phytoplankton, copepods, zooplankton, meso- and epipelagic fish, crabs, and cephalopods; and predator/prey items such as tuna (three species), porpoise (three species), sharks, toothed whales, and baleen whales. Each predator/prey item was divided into two age classes.

Models from a number of sources were evaluated for use as components of the ETP model. Data were taken from a variety of sources from the EASTROPAC Atlases to Bulletins of the Inter-American Tropical Tuna Commission. The researchers attempted to describe in mathematics and computer code the hypotheses that experts on ocean biology and physics claimed were responsible for the interactions observed. This approach has the advantage that failure of the model to represent known dynamics leads the researchers to determine which hypotheses are weak and thereby leads to further experimentation.

At the time of delivery of the model, the research team had identified the following as points deserving of immediate attention:

1. In the hydrodynamic model, all inputs and outputs of water into a cell were accounted for without allowing vertical flow across the thermocline. In the model, upwelling artificially moves nutrients with no net water flow. The resulting fluid flows are not always a satisfactory representation of the known oceanic flows and upwelling rates are crude estimates.

2. Phytoplankton production is a complicated function of light, temperature, nutrients, and phytoplankton mass. Each of the components of this function is relatively well-documented but the composite needs further analysis and careful parameter evaluation.

3. The interaction among organisms of the predator-prey group is restricted to competition for food. Migration is random in direction and food-dependent in magnitude.

4. Running an 8 x 7 cell subset of the total area for one-year costs $67.00 on the Burroughs B6700 at Utah State University. A one-year run produces an enormous amount of output that must be stored and intelligently condensed for interpretation.

Reward Offered for Return of Porpoise Tags

Fishery Biologist Jackie Jennings of La Jolla Laboratory's Marine Mammal Biology and Technology Program displays a poster offering rewards for the return of disc tags from porpoise inadvertently killed in purse seining operations.

The tags to be returned, placed on porpoises by researchers on board the dedicated vessel Queen Mary, include tags marking animals injected with tetracycline in a study aimed at providing a method for determining the ages of individual porpoises. Tetracycline, an osteophytic agent which is incorporated into bone, will fluoresce under ultra-violet light. The body of a tetracycline-tagged animal must be returned with the tag, so that researchers can examine the bones and determine the amount of layering which has taken place since tagging. Data from this study may eventually allow scientists to correlate bone layering and age in porpoises.

Jennings has distributed posters to all U.S. vessels, managing owners, and canneries involved with the tuna industry in the eastern tropical Pacific Ocean. The poster has also been translated into Spanish and sent to foreign countries participating in the tuna purse seining industry.

TUNA RESOURCES PROGRAM

Biological Sampling of Foreign Imports-of Atlantic Tunas Continues in Puerto Rico

Since March 1975, tunas caught in the Atlantic and transshipped to Puerto Rico have been sampled routinely by Technician Eugene Holzapfel of the La Jolla Laboratory for biological information, including fork length, weight, and species composition.

Results of sampling during the period from January 1978 through January 1979--with transshipments leaving Africa before January 15 included in the 1978 sampling--are as follows:

Species	Gear	No. of Samples	No. of Fish Sampled	Tonnage Sampled (MT)
Yellowfin	Baitboat	39	2162	109
	Purse Seine	11	472	2270
	Longline	1	50	106
Skipjack	Baitboat	23	1259	5300
	Purse Seine	25	1271	8468
	Longline	1	50	5
Bigeye	Baitboat	33	1408	576
	Purse Seine	6	224	515
Albacore	Longline	7	350	1682
TOTAL		146	7246	20017

Tuna Vessel Participation in FAX Advisory Program

During January 1979, 21 tuna seiners contributed synoptic weather data to the NMFS FAX Advisory Program. A total of 136 weather observations were reported via NMFS-licensed radio station WWD. The table below lists data pertaining to program participation during January, 1976-1979. Much of the monitored fleet spent January 1979 in port, which accounts in part for the low number of reports received during the month.

	JANUARY			
	1976	1977	1978	1979
Number of vessels with equipment	71	45	54	47
Number of vessels reporting	31	16	20	21
Number of weather observations reported	136	185	163	136
Number of XBT observations reported	28	5	10	0
TOTAL OBSERVATIONS	164	190	173	136

Captain Manuel Jorge and the crew of the tuna seiner Maria C J lead all program participants this month with 20 weather observations. NMFS extends its thanks to Captain Jorge and his crew and all other contributing participants.

PACIFIC ENVIRONMENTAL GROUP

OCEAN MODELING AND FORECASTING

Multispecies Model of the California Current Pelagic Species Under Development

One of the activities of the Ocean Modeling and Forecasting task is to develop environmental and density-dependent models of the life history features of California Current fishes. Information on the major pelagic species has now developed to a point that will allow multispecies modeling. Dick Parrish, Fishery Biologist and Donna Mallicoate, Statistician, have initiated development of a multispecies model of six of the major pelagic fishes of the California Current Region.

Model development will be based on the concept of linked single-species models. This concept allows an expansion of single-species models to include interrelationships between species. It is a method to build complexity into fisheries models one step at a time. The linked model utilizes standard dynamic pool single-species compartments which are linked by adding interspecies, density-dependent terms to growth, mortality, recruitment and yield equations. Where environmental effects can be demonstrated terms will be added in the same manner as for the interspecific effects. Transition intervals will be monthly or bimonthly to allow assessment of seasonal effect.

Initially, the model will consider two geographically separate compartments: a Southern California Bight compartment and a northern compartment. The model will later be revised to determine the effects of regional fisheries on the populations by considering four compartments: Mexican, southern California, central California and Pacific northwestern.

Exploitation portions of the model will include a Pacific Fishery Management Council (PFMC) submodel, which will establish annual quotas based on stock sizes, and a fleet model, which will determine exploitation rates based on the PFMC submodel, economics, and the stock sizes of other species.

TIBURON LABORATORY

FISH COMMUNITIES INVESTIGATION

Groundfish Management Plan Development Team Meets at the Tiburon Laboratory

The Groundfish Management Plan Development Team met at the Tiburon Laboratory on January 3 to 5 to revise the draft of the plan in response to reviewers' suggestions, including those of the Advisory Panel and the Scientific and Statistical Committee. Dr. Lenarz, Leader of the Rockfish Analysis Task at Tiburon Laboratory, and Dr. Donald Gunderson of the University of Washington were responsible for revising the stock assessment and management sections. Revisions included more documentation of techniques, new estimates based on updated statistics, analyses of possible management of Pacific Ocean perch, and new options on management units. The completed revisions have been sent to other team members for review before being considered at the upcoming Team Meeting in Newport, Oregon, January 31-February 2, 1979. The revised plan will then be submitted to the Management Council at its March meeting in Eureka.

Techniques to Analyze Groundfish Data Developed

Effective management of Northern Pacific groundfish will require continual modification of the Management Plan based on new data. A rich source of such data is the Oregon Department of Fish and Wildlife. During most of the month, James Golden of that organization was at the Tiburon Laboratory, where he discussed the various types of analyses best suited to management procedures under the plan with Economist Ed Ueber, Computer Specialist Nancy Wiley, and Dr. Lenarz. Lenarz also gave instructions on techniques of stock assessment and including the use of several packaged computer programs for that purpose.

FISHERIES DEVELOPMENT INVESTIGATION

Marketing of Shortbelly Rockfish Planned

Though shortbelly rockfish (Sebastes jordani) are probably the most abundant rockfishes found off California, these fishes are not presently utilized, primarily due to their small size. Preliminary research at the Tiburon Laboratory has shown that a number of markets may be available, depending on costs. A fishing trip is being planned for late February or early March to provide samples for potential markets, which include the canning industry for both human and pet consumption, "surimi" or ground fish flesh used in fishcake and fish sausages, and the fresh and frozen fish trade.

Sus Kato, Leader of the Fishery Development Investigation, met with fisherman, Don Bischop, and owners of Schnaubelt Fisheries at Fort Bragg on January 16, 1979, to plan the disposition of the catch of shortbelly rockfish.

Rock Crab Meat Yield Investigated

A few crab traps were set late this month by Lt. Patrick J. Rutten of the NOAA Corps at the Johnson Oyster Ranch at Point Reyes. Captured crabs will be used to determine the yield of meat and allow comparison of costs between rock crab and Dungeness crab. The meat of the latter is being sold at around $9.00 per pound in the Bay area.

Recreational Fisheries Improvement

Fishery Biologist Roger Green began organizing the logistical details of the planned experiments on salmon imprinting next summer, involving 150,000 king salmon.

Changes in Angling Methods

During the month, Fishery Biologist Susan E. Smith of the Tiburon Laboratory submitted to the Center Director for approval the manuscript, "Changes in saltwater angling methods and gear in California." She also traveled to Long Beach, California, to obtain historical photographs of saltwater angling from the California Department of Fish and Game's photo archives. The photoas will be used to illustrate the manuscript which Smith plans to submit to Marine Fisheries Review.

Manuscript to be Published

During January, page proofs of the manuscript, "San Francisco Bay Fisheries--Past, Present and Future," were received by co-authors Susan E. Smith and Susumu Kato, Fishery Biologists at Tiburon Laboratory. The proofs were corrected and returned to the editor. The paper will appear as a chapter in the book, "San Francisco Bay--The Urbanized Estuary," due to be published this spring by the American Association for the Advancement of Science.

PHYSIOLOGY INVESTIGATION

Manuscript Underway

The staff of the Physiological Ecology Program is in the process of completing data analysis and preparation of a manuscript to be presented at the Symposium on "The Early Life History of Fish," to be held in April at Woods Hole, Massachusetts. The paper is titled, "The effect of inherent parental factors on gamete condition and viability in striped bass," by Jeannette A. Whipple, Maxwell B. Eldridge, Pete E. Benville, Brian Jarvis, Michael J. Bowers, and Nancy Stapp. The paper will cover results of studies made of striped bass adults during their spawning migration and the relationship of genetic variability and variability in condition of adults (due to pollutant uptake, disease, and previous stress) to viability and survival of eggs at spawning.

CORRECTION

We regret an error made in reporting the research of Dr. Edmund Hobson of Tiburon's Fish Communities Investigation, and Dr. Richard Grigg of the Hawaii Institute of Marine Biology in the November/December monthly. A corrected version of the report follows:

New Perspective Gained on Hawaiian Coral Reefs

Hawaiian reefs have long been recognized as differing from most Indo-Pacific coral reefs in the absence in Hawaii of corals of the genus Acropora. Acropora spp. are the major scleractinian corals on coral reefs. The absence of Acropora in Hawaii generally had been assumed to stem from low water temperatures in that area.

This month a joint study of coral reef communities, led by Dr. Edmund Hobson, of Tiburon's Fish Communities Investigation, and Dr. Richard Grigg, of the Hawaii Institute of Marine Biology, found Acropora to be a major component of reefs at French Frigate Shoals in the Northwest Hawaiian Islands where water temperatures are considerably lower than on the major Hawaiian Islands. Though a few small isolated heads of Acropora had been seen at French Frigate Shoals in the Northwest Hawaiian Islands and a small colony was collected at the high Island of Kauai, there had been no evidence that these were significant elements of the fauna. The joint NMFS-HIMB investigation, however, found Acropora to be the dominant coral on some reefs, with individual heads reaching a size of up to 5 meters in diameter. The group also found the coral-feeding butterfly fish, Chaetodon trifacialis, a widespread Indo-Pacific form unrecognized as a member of the Hawaiian fauna, to be numerous in close association with these corals.

HONORS AND AWARDS

Izadore Barrett, Director of the SWFC, accepted an appointment to the Advisory Council of the Institute of Marine Resources from Dr. David Saxon, President of the University of California. The Council provides advice and consultation in the technical areas of research and instruction, including the Sea Grant Program.

SEMINARS

La Jolla Laboratory

January 8 - Judith Tenney, Chief of the Career Development Branch of NOAA, gave a presentation on current trends of interpretation of NOAA training policies, upward mobility, career ladders, and some new programs in NOAA.

9 - Dr. Reuben Lasker, Leader of the Coastal Fisheries Resources Division, discussed "The relation between oceanographic conditions and larval anchovy food in the California Current: two contrasting years, 1975 and 1978."

19 - Dr. Martin Bilio, President of the European Mariculture Society in Bredene, Belgium, gave a talk on "Mariculture research in Europe."

23 - Dr. George Hunt, Jr. of the Department of Ecology and Environmental Biology at the University of California at Irvine, gave a presentation on "Sea birds as marine organisms: the food connection."

Honolulu Laboratory

January 25 - Dr. J. L. McHugh, Professor of Marine Resources, State University of New York, Stony Brook, New York, spoke on "Whaling: moratorium or rational use."

30 - Claude Nagamine, University of California, Davis, California spoke on "Hormonal control on sexual dimorphism in Malaysian prawns."

Tiburon Laboratory

Operations Research Analyst Peter Adams will serve as the co-chairman for a joint seminar series to be held with San Francisco State University. Dr. Erwin Seibel, Director of San Francisco State University's Tiburon facility, will be the other co-chairman.

MEETINGS AND TRAVEL

Honolulu Laboratory

January 3-5 - Richard Shomura, Director of the Honolulu Laboratory, traveled to SWFC La Jolla for discussions on central and western Pacific long-range fisheries development plan for tuna.

9-14 - Shomura attended the Pacific Islands Development Corporation meeting in Pago Pago, American Samoa.

18-19 - Shomura and several members of the Honolulu Laboratory staff met with staff from the La Jolla Laboratory, J. Awbrey of San Diego State University, and W. Evans of Hubbs-Sea World to discuss possible NSF/NMFS cooperative work to develop alternative means of fishing for large yellowfin tuna which would make fishing on porpoise unnecessary.

25-26 - Shomura participated in the Gilbert Islands negotiation meetings at Camp Smith.

La Jolla Laboratory

January 2-5 - Planning Officer D. Mackett traveled to Washington, D.C. to attend FY 1981 planning and budgeting meetings.

7-11 - F. Kellenberger, Data Manager, traveled to Honolulu to attend the Pacific Telecommunications Conference and to meet with Honolulu Laboratory personnel on data management activities.

8-12 - Center Director I. Barrett traveled to Molokai, Hawaii to attend the western Pacific Fishery Management Council's Statistical and Scientific Committee Meeting.

8 - Members of the La Jolla Laboratory staff attended a meeting of the Pacific Fishery Management Council held in San Diego. An amendment to the Anchovy Management Plan, written principally by Dr. D. Huppert at the request of Terry Leitzell, NOAA Assistant Administrator for Fisheries, was presented to the Council.

9 - O. Burris, Computer Programer, traveled to Long Beach to meet with Southwest Region and California Department of Fish and Game personnel regarding the Coastwide Data System.

16-19 - An evaluation of the MARMAP Program at the La Jolla Laboratory was conducted by Archie Ginn and Steven Forman from the NOAA Office of Program Evaluation and Budget, in order to examine in detail how the MARMAP program is being conducted and managed.

19-24 - The Center's Quarterly Management meeting was held at the La Jolla Laboratory.

22-26 - Data Manager F. Kellenberger traveled to Washington, D.C. to attend the National Data Management Committee meeting.

Tiburon Laboratory

January 3-5 - Dr. William H. Lenarz, Fishery Biologist, attended the Groundfish Management Plan Development Team Meeting held at the Tiburon Laboratory

- Economist Ed Ueber attended the Groundfish Management Plan Development Team Meeting held at the Tiburon Laboratory. The team members selected Ueber to serve as Co-chairman, along with Robert Demory of Oregon Department of Fisheries.

11 - Fishery Biologist Susan Smith travelled to California Department of Fish and Game's Office in Long Beach to select photographs from their files for use in an upcoming publication.

18 - Ueber travelled to Terminal Island to attend a meeting of the ad hoc Economic Committee of the Pacific Fisheries Management Council which was convened to prepare a call for proposals to study markets for groundfish, shrimp and Dungeness crab.

25-26 - Fishery Biologist Sus Kato traveled to Monterey to visit with personnel of the California Department of Fish and Game.

Pacific Environmental Group

January 21-21 - Dr. Douglas R. McLain, Oceanographer, traveled to La Jolla to attend a meeting on transfer of the tuna data program from the Navy's Fleet Numerical Weather Central to the National Weather Service.

24-26 - Oceanographer Andrew Bakun traveled to Washington,D.C. to attend a working group meeting on Fishery Climate Plans.

VISITORS

Honolulu Laboratory

January 2 - Mike McCoy, Director of the Micronesian Maritime Authority, Ponape, Eastern Caroline Islands, met with Director Shomura and Dr. Wetherall to discuss the summarization of foreign fishery statistics of interest to the Federated States of Micronesia.

4 - Acting Director Otsu discussed NWHI fishery information with Captain Gary "Skip" Naftel of the Easy Rider.

8 - Donna Pooley, Tuna Research Foundation, Washington, D.C. visited Otsu. Pooley was interested in the Honolulu Laboratory's research programs and library.

9 - Kosuke Morita, graduate student from Japan, visited Otsu. Hida and Higashi provided a tour to visit various fishery-related facilities for Morita.

10 - John C. Marr, International Center for Living Aquatic Resources Management, visited Otsu and other Honolulu Laboratory staff members.

15 - Mike Tansay, a U.S. mainland fisherman, discussed Hawaiian fisheries with Otsu and also visited the library.

17 - Kozo Yamada and Ramon Rechebei, Trust Territory of the Pacific Islands visited Shomura.

22 - Otsu met briefly with Dr. Gopalakrishnan from the Gilbert Islands.

25 - Dr. and Mrs. J.L. McHugh, Stony Brook, New York, visited Otsu and Dr. Mendelssohn.

- Mr. and Mrs. Frederick J. Laney, Washington, D.C. visited with several Honolulu Laboratory staff members. Laney is with the NMFS Office of Foreign Affairs.

26 - Dr. Yoshiaki Matsuda, Woods Hole, Massachusetts visited Otsu.

27 - Shomura was visited by Sixte Stein and Philippe Siu from Tahiti.

- Shomura discussed Hawaiian monk seals with Brian and Pattie Johnson.

La Jolla Laboratory

January 1 - Dr. Howard Feder of the University of Alaska, A.J. Paul, and Judy McDonald visited Dr. R. Lasker. These scientists will be involved in a University of Alaska project on pollock in the Bering Sea which Lasker is overseeing.

22-23 - Dr. George Innis and his group from Utah State University visited the La Jolla Laboratory to present their final report on the ecosystems analysis of the eastern tropical Pacific under contract to the Marine Mammal Assessment and Monitoring Program.

Pacific Environmental Group

January 8 - Mary DiJiulian, NMFS, Washington, D.C.

12 - Archie Ginn, NOAA Headquarters, Rockville, MD

- Steve Forman, NOAA Headquarters, Rockville, MD

15-16 - Dr. Maurice Blackburn, Friday Harbor, WA

- Dr. Frank Williams, University of Miami, FL

Tiburon Laboratory

January 2 - Tom Jow, California Department of Fish and Game, Menlo Park, CA

- Dr. Donald Gunderson, University of Washington, Seattle, WA

3 - Eric Anderson, San Anselmo, CA

5 - J. Bornstein, Bornstein Seafoods, Inc., Bellingham, WA
- Tony Carter, Horizon Trawlers, Inc., Sausalito, CA

- Dennis Grotting, Eureka, CA

- H. Haugen, Fishermen's Marketing Association, Seattle, WA

9 - James Golden, Oregon Department of Fish and Wildlife, Marine Science Center, Newport, OR

- Kristin Startz, National Marine Fisheries Services, Seattle, WA

- Douglas Stehl, Research Corporation, University of Hawaii, Honolulu, HI

10 - Steven D. Forman, NOAA, Program Evaluation and Budget, Rockville, MD

- Archie Ginn, NOAA, Program Evaluation and Budget, Rockville, MD

12 - Dennis Bonnert, Golden Gate Seafood, San Leandro, CA
22 - Dr. George M. Miller, Oakland, CA

23 - T. Arons, Unilab Research, Berkeley, CA

- Stephen A. Klein, U.C. Richmond Field Station, Richmond, CA

24 - E. El-Shafey, Mare Island, Vallejo, CA

- Gary Crawford, Mare Island, Vallejo, CA

- Fritz Kemple, Mare Island, Vallejo, CA

- Mark Purdy, Mare Island, Vallejo, CA

29 - T. Ichinose, S.B.S. Fishing Company, San Francisco, CA
31 - Dean Farren, Sausalito, CA

PUBLIC RELATIONS

Honolulu Laboratory

H. Uchida served as moderator for the Food From the Sea Panel which was part of the Fourth Annual Student Symposium on Marine Affairs sponsored by the Hawaii Department of Education and University of Hawaii Sea Grant.

Research Assistant Martina Queenth hosted a class of academically gifted 6th grade students and their teacher, Elsie Tanaka, from Mililani-Uka Elementary School at our Kewalo facilities.

PRESS RELEASES

Honolulu Laboratory

January 16 - Professor J.L. McHugh, noted scientist, to lecture on whales.

La Jolla Laboratory

January 11 - NOAA Scientists to Survey Porpoise Populations in Eastern Pacific.

29 - US/Soviets to Embark on 10th Year of Cooperative Fisheries Surveys off California Coast.

PERSONNEL

La Jolla Laboratory

January 2 - Robert Salomons, Biological Technician - Temporary Appointment.

3 - Raul Freitas, Student Assistant - Resignation.

8 - Thomas Polacheck, Fishery Biologist - Temporary Appointment

15 - Cynthia Thompson, Economist - Temporary Appointment

28 - Tod Foster, Biological Technician - Promotion

- Dennis King, Industry Economist - Resignation

- Stanley Moore, Computer Technician - Promotion

- Lonnie Dick, Biological Aid - Temporary Appointment

Honolulu Laboratory

January 1 - Cathy McNamara, Data Transcriber - Resignation

12 - Randolph K.C. Chang, Biological Technician - Change in title to Fishery Biologist (General).

16 - Henry M. Kishinami, Biological Aid (Fisheries) - Completion of 700-hour Appointment.

22 - George C. Evering, Biological Technician (Fisheries) - Temporary Appointment NTE 9/29/79.

- Alan R. Everson, Biological Technician (Fisheries) - Temporary Appointment NTE 9/29/79.

29 - Andrew J. Aldridge, Biological Technician (Fisheries) - Temporary Appointment NTE 9/29/79.

Tiburon Laboratory

January 15 - Kathleen M. Fourre, Biological Aid - Temporary Appointment.

UNITED STATES
DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST FISHERIES CENTER
8604 LA JOLLA SHORES DRIVE
P.O. BOX 271
LA JOLLA, CALIFORNIA 92038

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

AN EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID
DEPARTMENT OF COMMERCE
210

THIRD CLASS